Analysis of Retrospective Chest CT Findings to Assess Clinical Significance and Evaluate Diagnostic Pitfalls

Chara Rydzak, MD PhD
Hospital of the University of Pennsylvania, Philadelphia, PA
Purpose

• Radiologists continually seek to eliminate errors of interpretation and improve diagnostic performance and quality of care for patients.

• Learning from review of prior “misses” or through follow-up of ambiguous findings plays an important role in improving image interpretation and reducing errors related to imaging pitfalls.

• However, often only a small subset of individual selected “misses” or ambiguous findings are identified and reviewed for learning purposes.

• This pilot study sought to analyze and categorize retrospective findings referenced in chest CT reports from an anonymized dataset of all chest CT reports to provide more generalizable results, identifying and quantifying types of diagnostic pitfalls associated with retrospective findings and thereby improve diagnostic accuracy.
Background:

• Retrospective findings can range from insignificant (e.g. normal anatomic variants) which do not impact clinical care to clinically significant findings (e.g. missed lesions) that potentially change clinical management.

• According to Ropp et al. approximately 4% of radiology reads contain errors. ²

• A retrospective review of discrepant findings between residents and attendings showed that of 2255 preliminary interpretations, 29 were found to be potentially clinically significant with 2.1% of CT discrepancies predicted to be clinically significant. ¹

• Driscoll et al. state “Potential causes of a reporting discrepancy include; inadequate, misleading or incorrect clinical information, poor imaging technique, excessive workload or poor working conditions, observation/interpretation errors and ambiguity of wording or summary of report. Radiological interpretation is not an exact science. It involves decision making under conditions of uncertainty and a certain degree of error is inevitable and is well-recognized.” ⁵

• Errors may be perceptual or interpretational with the majority of errors reportedly perceptual in nature. Donald et al. found that 80% of errors were perceptual with CT and plain films being the most frequent modalities. ³
Methods

• A database of radiology reports from January 1, 1988 to May 19, 2013 was searched for references to retrospective findings using the key word "retrospect" in chest CT reports.*

• A subset of anonymized chest CT reports identifying retrospective findings was analyzed.

• Each reference was categorized by type of retrospective finding – Clinically Significant, Insignificant or Indeterminate.
  • Clinically Significant findings had the potential to change clinical management.
  • Insignificant findings included references to known, unchanged, or incidental findings that would not alter management.
  • Indeterminate findings were of ambiguous clinical significance.

• Clinically Significant findings were analyzed to identify key features affecting diagnostic interpretation.

*Presto beta version
Results

• A total of 14,501,080 radiology reports were searched which included a total of 296,964 chest CTs.

• 1569 chest CT reports referenced retrospective findings of which a subset of 301 reports were analyzed.

• A total of 73 retrospective findings were Clinically Significant, 199 were Insignificant, and 29 were Indeterminate.

• Of Clinically Significant findings, 40% were too subtle/small to characterize on prior imaging, 14% were not identified due to artifact or limitations of prior imaging technique, 4% were obscured by superimposed pathology, 14% represented differences in interpretation, and 28% were findings missed without reported associated confounding factors.

• Missed Clinically Significant findings included 3 recurrent malignancies, 4 metastatic lesions, and 7 lesions suspicious for primary neoplasm.

• When accounting for confounding factors, overall diagnostic accuracy was high with potentially missed recurrent, primary or metastatic lesions of less than 5%.
Distribution of Types of Retrospective Findings

- Clinically Significant Findings: 24%
- Clinically Insignificant Findings: 66%
- Indeterminate Findings: 10%
### Identifiable Confounding Factors Associated with Clinically Significant Finding

<table>
<thead>
<tr>
<th>Factor</th>
<th>Number of Instances</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical or Artifact</td>
<td>10</td>
</tr>
<tr>
<td>Too Small or Subtle</td>
<td>29</td>
</tr>
<tr>
<td>Obscured by Pathology or Anatomy</td>
<td>3</td>
</tr>
<tr>
<td>Difference of Interpretation</td>
<td>10</td>
</tr>
<tr>
<td>No Modifying Factor</td>
<td>21</td>
</tr>
</tbody>
</table>
Types of Clinically Significant Findings in the Subset of Findings without Reported Confounding Factors

- PE or Thrombus: 14%
- Recurrent Malignancy: 9%
- New Malignancy: 19%
- New Metastasis: 33%
- Infection: 5%
- Pneumothorax: 10%
- Fracture: 5%
- Bronchopleural Fistula: 5%
Confounding Factors Impacting Identification of Clinically Significant Findings

• 71% of Chest CTs with Clinically Significant retrospective findings were associated with confounding factors that impacted identification of findings in the initial study.

• 58% of clinically significant retrospective findings were initially not identified due to limitations of visualization on the initial imaging study including:
  • The finding was either too small or subtle to be recognized except in retrospect.
  • The finding was obscured by other pathology.
  • Technical limitations or imaging artifacts in the original study precluded identification (e.g. non-contrast study, motion or streak artifact).

• 14% of clinically significant findings were due to a retrospective change in the initial radiologist’s diagnostic interpretation of the original imaging study on follow-up imaging; however, this represented only 3% of all retrospective findings analyzed (e.g. significant, insignificant and indeterminate retrospective findings).
Discussion:

• This study further investigates the range of retrospective findings that could change clinical management versus those that are clinically insignificant.

• By using a dataset of all anonymized chest CT reports that referenced retrospective findings, reporting bias associated with individual reporting of errors was reduced, making results more generalizable by capturing a wider range of retrospective findings that might otherwise not be formally reported and analyzed.

• Errors and retrospective findings are inevitable but efforts to analyze sources of errors and learn from prior missed findings can help illuminate diagnostic pitfalls and system issues, thereby helping to improve patient care and safety.
Conclusion

• Limitations due to overlying pathology and imaging resolution, technique and artifacts impacted diagnosis most frequently.

• Changes from the initial radiologist’s diagnostic interpretation of identified findings accounted for only 3% of all retrospective findings.

• Of potentially clinically significant findings with no reported confounding factor, retrospective findings included 3 recurrent malignancies, 4 metastatic lesions, and 7 lesions suspicious for primary neoplasm.

• However, overall accuracy remained high with potentially missed recurrent, primary or metastatic lesions accounting for less than 5% of retrospective findings, consistent with reported rates in the literature.

• Evaluation of retrospective chest CT findings provides important insights for improving diagnostic accuracy and understanding sources of diagnostic pitfalls in interpretation.
References


